

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

Processing – Structure – Properties of Thermal Sprayed Coatings

By

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Thermally sprayed ceramic coatings are fabricated with melted or semi-melted particles that solidify on substrates. The successive spray generates a unique lamellar microstructure with pores and cracks. These cracks give rise to nonlinear mechanical response under tension and compression loads. A novel method to estimate the nonlinear properties of ceramic coatings is proposed. In this approach, measured substrate curvature-temperature records are post-processed by inverse analysis. Based on Kalman Filter technique, the inverse method uses indirect measurable experimental data to extract key unknown parameters. Bimaterial beam solutions were derived to provide the forward relationship between material properties and experimental curvature-temperature measurements. The robust procedure was verified with detail finite element simulation of thermal spray process.

Coating mechanical properties are highly dependent on powder properties and processing parameters during spraying. The properties of powders are expressed by their sizes, morphology and compositions. The spray process parameters control particle temperature, velocity, plasma power, spray distance, speed and angle. The proposed novel method was applied to analyze the effects of different feedstock and processing parameters on ceramic coating nonlinear properties. Desired or specific properties can be obtained by varying powders and processing parameters.

Nonlinear behavior of thermally sprayed ceramic coatings is not purely elastic but anelastic. Hysteresis of curvature appears during stress cycling. Curvatures as a function of temperature are different under heating and cooling, which show the stress strain relations of coating are anelastic. In the present study, crack sliding with friction model was proposed to study the hysteresis mechanism.

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Dissertation Advisor: Professor Toshio Nakamura